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Iatrogenic accessory nerve injury

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Accessory nerve injury produces considerable disability. The nerve is most frequently damaged as a complication of radical neck dissection, cervical lymph node biopsy and other surgical procedures. The problem is frequently compounded by a failure to recognise the error immediately after surgery when surgical repair has the greatest chance of success

We present cases which outline the risk of accessory nerve injury, the spectrum of clinical presentations and the problems produced by a failure to recognise the deficit. Regional anatomy, consequences of nerve damage and management options are discussed.

Diagnostic biopsy of neck nodes should not be undertaken as a primary investigation and, when indicated, surgery in this region should be performed by suitably trained staff under well-defined conditions. Awareness of iatrogenic injury and its consequences would avoid delays in diagnosis and treatment.

The severe disability associated with injury to the spinal accessory nerve (SAN) has long been recognised, with pain, weakness and paraesthesia among the major presenting features *(1–3)*. Although alternative traumatic mechanisms of SAN lesions have been described *(4,5)*, most lesions are iatrogenic. These injuries are the most common iatrogenic nerve injuries referred to our practice.

The nerve is most frequently damaged in the posterior triangle of the neck as a complication of a variety of procedures performed by surgeons of different specialties. The main cause for concern is the high incidence of SAN injury after posterior triangle lymph node biopsy. This has been estimated in one study to occur in between 3% and 10% of such procedures *(3)*. Injury to the nerve during the course of node biopsy should be avoidable with proper care and adequate anatomical knowledge.

Unfortunately, these lesions continue to occur and to present problems in diagnosis. In all cases the deficit is noted early by the patient but often their complaints are not interpreted accurately by medical staff. The delay in diagnosis may prevent effective treatment. Even when an accurate diagnosis is made, further delays often occur before definitive treatment.

Case studies

The following cases of iatrogenic SAN injury, referred to a plastic surgery unit, have been selected as they illustrate the variety of clinical presentation of these lesions and serve to highlight pitfalls in diagnosis and management. Therapeutic options available are discussed as an indication of the importance of early diagnosis and appropriate management.

Case 1

A 31-year-old obstetric trainee underwent right cervical lymph node biopsy to provide a diagnosis for persistent lymphadenopathy. The procedure was performed under general anaesthesia by a clinical assistant in surgery. Immediately after the procedure the patient noted weakness of the right shoulder. This persisted, with an inability to sustain abduction of the arm to 90° as its most marked feature. The patient also noted pain over the right trapezius, lateral side of the neck and across the lateral border of the shoulder down to the olecranon.

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The patient was referred to the plastic surgery unit 6 months later. Examination at that time revealed the right trapezius to be wasted with marked drooping of the right shoulder. Contraction of the lateral fibres of the trapezius was absent; the vertical fibres contracted weakly. Using these fibres and levator scapulae, the patient was able to 'shrug' her shoulders, but arm abduction could not be sustained for more than a few seconds. Function of the right sternocleidomastoid was unaffected. Surgical exploration of the old scar was undertaken and a 3-cm defect in the SAN, with an associated neuroma, was identified. Microsurgical repair was performed using a sural nerve graft.

At 3 years after surgery the patient had returned to obstetric practice, but could only work in outpatients, being unable to sustain abduction or flexion at the shoulders long enough to deliver a baby. Difficulty in sustained abduction and elevation of the right arm persisted and in addition the patient described paraesthesia of the ulnar border of the right forearm and hand. Examination revealed some improvement in trapezius wasting and an improvement of shoulder droop, although early fatigue persisted in abduction. A positive Tinel's sign over the brachial plexus radiated to the ulnar digits. At 4 years, she was significantly improved with only mild wasting now apparent and able to hold the arm abducted for more than 30 s.

Case 2

A 35-year-old housewife underwent biopsy of a solitary lymph node in the right posterior triangle of the neck, by a junior doctor, as a primary investigation of cervical lymphadenopathy. The only other investigation performed before the procedure was a full blood count. Immediately postoperatively the patient noted difficulty elevating the right arm and pain over the shoulder. She reported these symptoms to nursing and medical staff and was reassured that they were the result of lying awkwardly on the operating table and that they would resolve. It was noted that she was able to shrug her shoulders. Some months later she developed tingling in her ring and little finger on that side and was referred to a rheumatology clinic. A diagnosis of hysteria was made. The patient was reviewed in the plastic surgery unit, for medicolegal purposes, 3 years later after recognition of her symptoms. At the time of review, the patient reported four symptoms affecting daily living:

1 Pain over the right side of the neck and scapula and tenderness over the trapezius.
2 Drooping of the right shoulder.
3 Weakness of the right arm associated with an inability to elevate the shoulder girdle or to abduct the arm to more than 70°.
4 Tingling and numbness of the ulnar border of the right forearm and hand increased by exercise.

Examination revealed a short transverse scar directly over the normal course of the right SAN in the posterior triangle. Marked wasting and weakness of the trapezius muscle was noted, resulting in limitation of abduction and an inability to sustain such abduction. Subjective alteration in sensation over the ring and little fingers was not accompanied by alteration in two-point discrimination or obvious muscle wasting; however, both grip strength and key pinch strength were markedly reduced. No surgical repair was undertaken in view of the prolonged delay since the injury.

Case 3

A 47-year-old optician with a previous history of lymphoma presented with an enlarged lymph node in the right posterior triangle. Biopsy to exclude recurrent disease was performed under general anaesthesia by a consultant surgeon. Histology showed benign changes only. Postoperatively, the patient noticed weakness of the right arm and was unable to conduct his ophthalmic practice. Early referral was made to the plastic surgery unit where the patient was noted to have wasting and weakness of the right trapezius with marked postural droop of the right shoulder. Electromyographic studies confirmed denervation of the trapezius. At exploration a neuroma, in continuity with the SAN, was found. Microneurolysis and intraoperative stimulation failed to show fibres in continuity and a short microsurgical nerve graft from the cervical plexus was used to reconstruct the defect. At review after 12 months a substantial improvement in symptoms and signs was noted but, ironically, a lump discovered at this time, in the region of the surgical scar, was shown histologically to be a recurrence of his lymphoma.

Case 4

An 11-year-old child underwent excision of an acutely inflamed lymph node in the right posterior triangle. After surgery she developed weakness (particularly in abduction) and drooping of the right shoulder. Electromyography failed to demonstrate denervation of the trapezius but clinical examination 4 months later revealed wasting of the right trapezius with shoulder droop and marked diminution of spontaneous activity in the trapezius. The patient underwent exploration of the old scar; a 5 cm deficit in the right SAN was discovered. The nerve was reconstructed with sural nerve from he right leg with good postoperative recovery of shoulder posture, muscle bulk and function at 18 months.

Discussion

These cases exemplify the features of many referred to our unit and highlight the following key issues:

1 Surgery in the neck is often performed by inexperienced surgeons on patients who might be spared surgery by other investigations.
2 After the procedure, failure to recognise patients' symptoms leads to inappropriate reassurance of the patient; informed examination of the patient at this stage would lead to early recognition.
3 Despite the well-defined functional role of the SAN, a variety of symptoms is seen.

4 Even after a preliminary diagnosis of an SAN lesion has been made there are still unacceptable delays before referral to a specialist unit.
5 Early exploration and treatment significantly improves the chances of functional recovery.

Regional anatomy of the spinal accessory nerve

The spinal component of the accessory nerve arises as a series of rootlets from the lateral surface of the cephalad five segments of the spinal cord. They unite to form a single trunk which ascends through the foramen magnum into the posterior cranial fossa. Here it is joined by the cranial root before leaving the skull through the middle compartment of the jugular foramen lateral to the vagus nerve. All the cranial root fibres leave the nerve to join the vagus, distal to the jugular foramen; the remaining fibres, constituting the SAN, descend into the neck intimately related to the internal jugular vein. It passes deep to the styloid process and posterior belly of the diagastric giving off a motor branch to the sternomastoid before passing deep to (or occasionally through or superficial to) that muscle. It emerges on the posterior border of the muscle at the junction of the middle and upper thirds. It then passes almost vertically downwards across the floor of the posterior triangle, over levator scapulae and embedded in the deep cervical fascia to pass beneath the anterior border of the trapezius at the junction of its middle and lower thirds (Fig. 1).

Anatomical studies have demonstrated the existence of connections between the SAN and other nerves in the root of the neck, most importantly, the cervical plexus. In up to 70% of cases as many as three branches from the 3rd and 4th cervical roots have been found to connect with the SAN via the cervical plexus in the posterior triangle *(6)*. Deep to the trapezius further connections with branches of the cervical plexus may occur. These cervical branches may provide additional motor input to the trapezius *(7)* and in a small number of cases the sole motor innervation of the muscle is of cervical plexus origin *(8)*. Considerable variation in the degree of participation of the cervical plexus in the innervation of the trapezius muscle has been demonstrated *(6,8)* and this variability explains some of the variation in symptoms seen after section of the SAN. Additional connections of the SAN to the trigeminal, facial, phrenic nerves, brachial plexus, stellate ganglion and ansa cervicalis have been described *(9)*.

The surface markings of the SAN can be demonstrated by drawing a line from the transverse process of the atlas (palpable anterior to the mastoid) to the anterior border of the trapezius 5 cm above the clavicle.

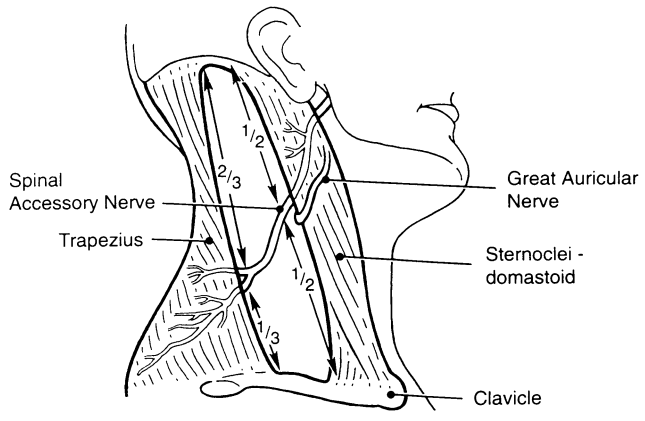

Figure 1. The accessory nerve as it passes across the floor of the posterior triangle in the root of the neck.

Clinical features of accessory nerve injury

A clinical picture associated with SAN injury has been described *(1)*; however, in practice, the patient may present with a variety of symptoms and signs. Clinical features, due primarily to the paralysis of the trapezius muscle may be divided into immediate and late *(3)*. Immediate symptoms, recognised by the patient, include pain over the affected muscle, limitation of movement (in particular, loss of abduction), and a feeling of heaviness in the arm. Late sequelae of the injury are as follows:

1 Drooping of the shoulder secondary to trapezius paralysis (Fig. 2*a*);
2 Atrophy of the trapezius with appreciable asymmetry (Fig. 2*b*);
3 Weakness or loss of shoulder abduction (usually less than 90°);
4 Pain which is usually mild—a persistent ache in the region of the affected muscle—but may be severe and involving not only the shoulder but also the arm, forearm, hand, scalp, and face of the affected side. Contralateral pain has also been recorded *(6)*. The aetiology of this pain is not completely understood, but theories include traction on the cervical sensory nerves or traction on the brachial plexus as a result of postural changes, direct damage to sensory fibres in the SAN derived from the cervical plexus and entrapment syndromes *(10)*;
5 Subjective sensory disturbance including paraesthesia in the forearm and fingers secondary to traction on the brachial plexus and impingement on the first rib.

Clinical examination of suspected accessory nerve injury

In our experience, examination of the function of the SAN is not fully appreciated. Observation often reveals drooping of the shoulder, and inferior and lateral rotation of the scapula on the chest wall associated, occasionally, with winging of the scapula *(11)*. Sustained abduction of the arm is severely limited and is the single most consistent finding on examination. Although atrophy is not evident in the early months, palpable contraction of the superior component of the trapezius is absent from the time of injury. Shrugging of the shoulder may be possible using some residual fibres of the trapezius and levator scapulae, controlling scapular rotation with serratus anterior. Sternocleidomastoid function is assessed by resisted rotation of the head towards the unaffected side.

Figure 2. (a) Patient with accessory nerve injury showing drooping of right shoulder. (*b*) Wasting of the right trapezius muscle is clearly demonstrated.

Further examination includes percussion for Tinel's sign and neurovascular assessment.

Investigations

Evaluation of SAN lesions is occasionally enhanced by electromyographic studies; however, these normally have little to add to a thorough clinical examination *(12)*.

Management options

Spontaneous recovery after accessory nerve division has not been described *(1)*. Conservative therapy, shoulder bracing, scapula fixation and physiotherapy have been shown to be of little long-term benefit *(3,4,9)*. As early as 1946 *(1)* the value of early diagnosis and surgical repair of the injured nerve was described, and this recent series has confirmed the advantage of surgical intervention with regard to symptomatic recovery *(4,13)*. In patients with an intact but damaged nerve, the only reliable method of predicting spontaneous recovery is by serial nerve conduction studies; however, such studies delay treatment until the results of operative intervention are likely to be poor. In one large series, surgical treatment was proposed unless there were historical, clinical or electromyographical evidence of axonal re-innervation of muscle by the time of initial referral *(13)*.

Operative intervention is most effective within 3 months of injury *(4,14)*. Neurolysis may be sufficient in some cases where the nerve has not been divided. In the divided SAN, a direct nerve repair is never possible since the nerve ends cannot be brought together without tension because of shoulder droop and, therefore, nerve grafting is preferred. Patients with distal lesions, in whom a distal stump cannot be found, have a very poor prognosis, even following neurotisation by implantation of the proximal stump into the trapezius.

Conclusions

Unintentional iatrogenic SAN injury should be avoidable. In particular, diagnostic biopsy of neck nodes should not be a primary investigation. Once a decision has been taken to perform such a biopsy, damage to the main components of the neck should be avoidable if the surgery is performed in optimal conditions by suitably trained staff with a good understanding of local anatomy. We recommend general anaesthesia, local vasoconstrictors, magnification and use of a disposable nerve stimulator. It is important that the SAN is identified and meticulously preserved during the operation.

After surgery particular notice should be taken of the patient's symptoms as these lesions are usually recognised by the patient in the immediate postoperative period. Early diagnosis and prompt treatment at this stage are associated with improved prognosis. Electromyographic studies are of relatively minor importance compared with a thorough clinical examination, which must not misinterpret residual ability to shrug the shoulders. Ability to maintain arm abduction at 90° must be examined. Treatment of the lesion should be by surgical intervention in virtually all cases as conservative treatment is associated with a dismal outcome.

Although the pitfalls of management of patients with injury to the SAN have been highlighted, the emphasis should be placed on prevention to avoid such a disabling condition.

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